

1. State whether the following compounds have ionic or covalent bonding.

LiF
Ionic

CF₄
Covalent

CaO
Ionic

NH₃
Covalent

PCl₃
Covalent

CuCl₂
Ionic

2. Write the formulas of the following compounds.

a. Magnesium oxide **MgO**

g. Magnesium fluoride **MgF₂**

b. Barium sulfate **BaSO₄**

h. Potassium sulfate **K₂SO₄**

c. Calcium hydroxide **Ca(OH)₂**

i. Ammonium carbonate **(NH₄)₂CO₃**

d. Sodium oxide **Na₂O**

h. Silver sulfide **Ag₂S**

e. Strontium sulfide **SrS**

i. Silver nitrate **AgNO₃**

f. Aluminum oxide **Al₂O₃**

j. Ammonium chloride **NH₄Cl**

g. Lithium nitride **Li₃N**

k. Copper nitrate **Cu(NO₃)₂**

g. Magnesium phosphate **Mg₃(PO₄)₂**

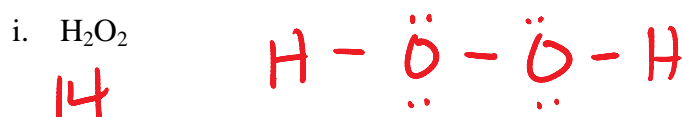
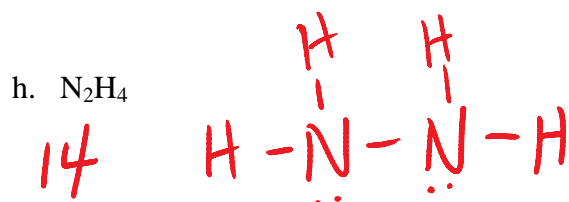
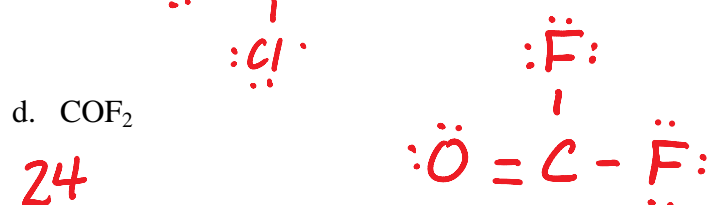
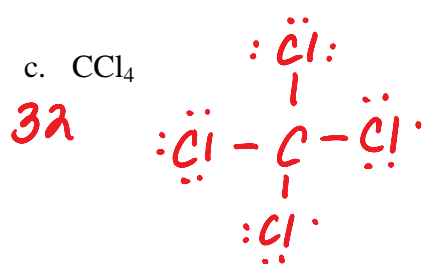
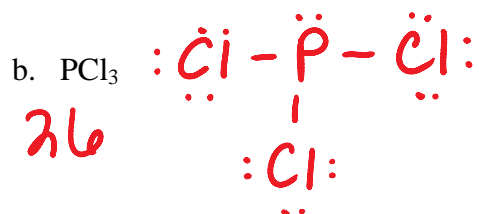
l. Rubidium carbonate **Rb₂CO₃**

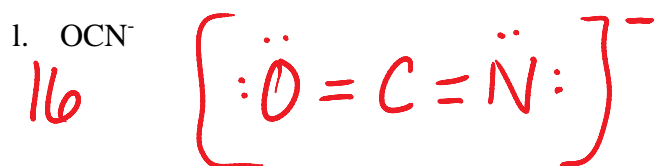
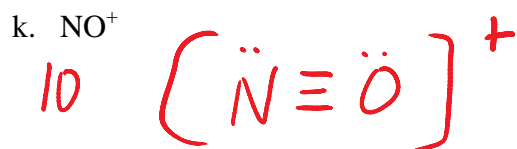
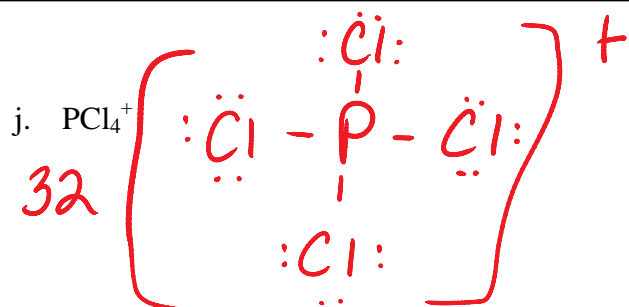
3. Work out Lewis structures for the following:

a. H₂S

8







4. Work out the geometry of the following molecules or ions and predict their bonding angles:



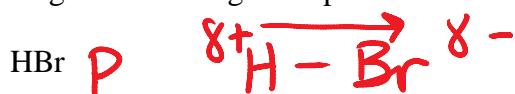


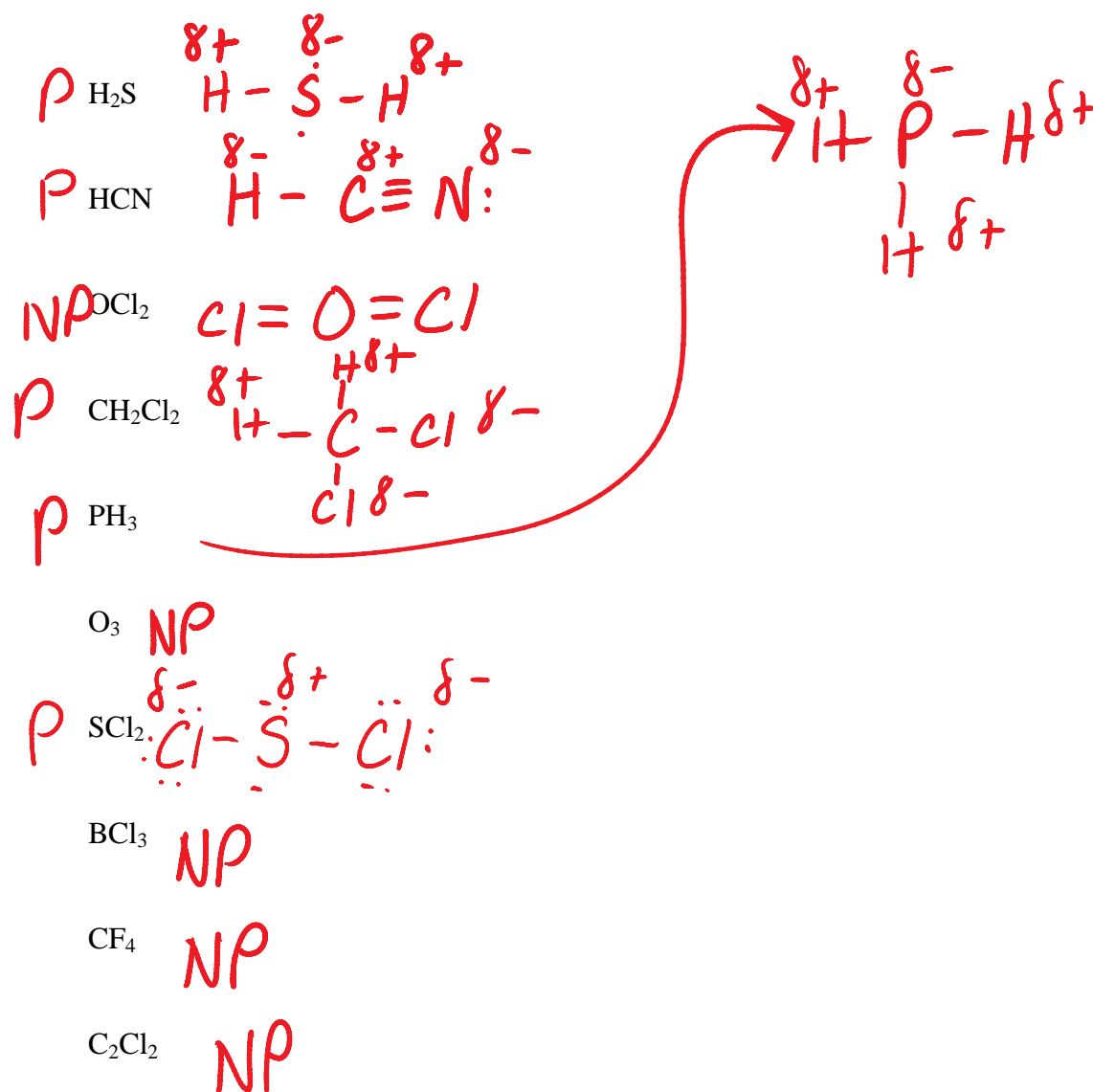
5. Arrange the following atoms in order of electronegativity (smallest first):

Cl O H Br Na

Na < H < Br < Cl < O

6. Select the polar molecules from the following list. For the polar molecules, draw diagrams showing the dipoles.





7. Arrange the following molecules in order of increasing boiling point (lowest first):

a. CH_4

CCl_4

CF_4



b. NH_3

PH_3

AsH_3



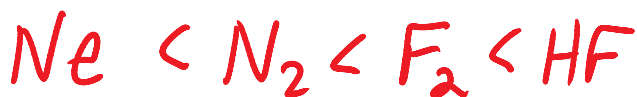
c. NH_3

N_2H_4

CH_4



↑ more H bonds

d. CH_3OH CH_3F C_2H_4 e. H_2O H_2S H_2O_2 f. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$ $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ g. N_2 F_2 HF Ne 

8. Arrange the following substances in order of increasing boiling point:

a. NaCl SiCl_4 CCl_4 HCl b. Br_2 HBr CaBr_2 PBr_3 c. C_4H_{10} $\text{C}_3\text{H}_7\text{OH}$ C_3H_8 $\text{CH}_3\text{CH}_2\text{COOH}$ $\text{C}_4\text{H}_9\text{OH}$ 

9. Arrange the following in order of increasing boiling point (lowest first):

a. SO_2 SiO_2 CO_2 b. $\text{C}_{(\text{diamond})}$ Si C_{60} 

- c. Al Mg Na

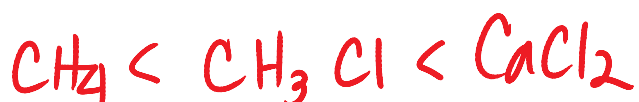


10. Arrange the following in order of solubility in water (least soluble first):

- a. NaCl C₆H₁₂ C₅H₁₁OH



- b. CH₃Cl CaCl₂ CH₄



OLD IB TEST PROBLEMS

11. What is the formula of the compound formed between lithium and nitrogen?

- a. LiN₂
b. LiN₃
c. Li₃N
d. Li₃N₂

12. Which of the following contains both ionic and covalent bonding?

- a. NaCl c. CCl₄
b. NH₄Cl d. PCl₃

13. What is the shape of NO₂⁺?

- a. Linear
b. Bent
c. Trigonal Planar
d. Tetrahedral



14. Which of the following is polar?

- a. CO₂ c. BF₃
b. CCl₄ d. PCl₃

15. Which of the following molecules exhibits hydrogen bonding?

I. NH_3

II. CH_3NH_2

III. HF

IV. CH_3F

a. I, II, and III only

b. IV only

c. I and III only

d. III and IV only

16. In which of the following are molecules arranged in order of increasing boiling point (lowest first)?

a. NH_3

N_2

Br_2

b. H_2O

H_2S

H_2Se

c. CH_3Cl

CH_2Cl_2

CHCl_3

d. C_4H_{10}

C_3H_8

$\text{C}_2\text{H}_5\text{OH}$

17. What is the F—B—F bond angle in BF_4^- ?

a. 109.5°

b. 107°

c. 120°

d. 90°

18. Which of the following will be the worst conductor of electricity?

a. $\text{Mg}_{(s)}$

b. $\text{SiCl}_{4(l)}$

c. $\text{MgCl}_{2(l)}$

d. $\text{C}_{(\text{graphite},s)}$

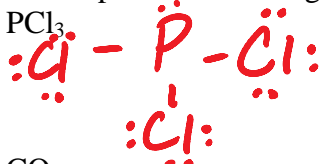
19. Complete the following.

a. Describe the principles of the valence shell electron pair repulsion theory for predicting the shapes of molecules.

Electron pairs will repel each other and try to take up space to be as far apart as possible in order to minimize repulsion. Pairs can be bonded or lone pairs, where lone pair will have a greater repulsion than bonded pairs.

b. Predict the shapes and bond angles of the following molecules:

i. PCl_3



107°

ii. CO_2



180°

- c. Explain why carbon dioxide is a non-polar molecule but sulfur dioxide is polar.
In CO₂ the dipoles cancel due to the molecule being linear, in SO₂ there is a lone pair of electrons on S and the molecule is then bent, so the dipole will not cancel and a permanent dipole will exist
- d. Draw a Lewis structure for carbon monoxide and explain whether it has a shorter or longer C—O bond length than carbon dioxide.
CO has a triple bond where CO₂ has 2 double bonds, Triple bond is a SHORTER bond length



20. Explain the following in terms of structure and bonding.

- a. Sodium oxide has a high melting point, does not conduct electricity when solid but conducts electricity when molten.
Sodium oxide is ionic. When a solid the ions are held in a lattice structure by electrostatic attraction between positive and negative ions. It does not conduct electricity when solid because the ions are held tightly in the lattice structure. When molten the ions are free to move away from each other and the liquid will conduct electricity
- b. Sodium has a lower melting point than magnesium.
Both have metallic bonding, Mg has a higher positive charge than Na so there is a stronger attraction between Mg ion and the delocalized electrons. Also Mg is smaller than Na so the delocalized electrons can get closer to the nucleus. AND
- c. Phosphine, PH₃, has a lower boiling point than ammonia, NH₃, and arsine, AsH₃.
All three are covalent. Phosphine and Arsine both are polar and have van der Waals and dipole dipole forces, since the forces are similar the phosphine and arsine boiling points are dependent on the molar mass, so phosphine is smaller so lower bp. Ammonia although smaller has H attached to a N so can have H-bonding so stronger IMF so highest bp
- d. Silicon dioxide has a much higher melting point than carbon dioxide.
Silicon Dioxide is a giant covalent where Carbon Dioxide is a non polar covalent. When SiO₂ is melted the covalent bond must be broken which requires a lot of energy. When CO₂ is melted the IMF are broken which requires less energy so has a lower MP